

The Day His World Stood Still

by Joanna Schaffhausen

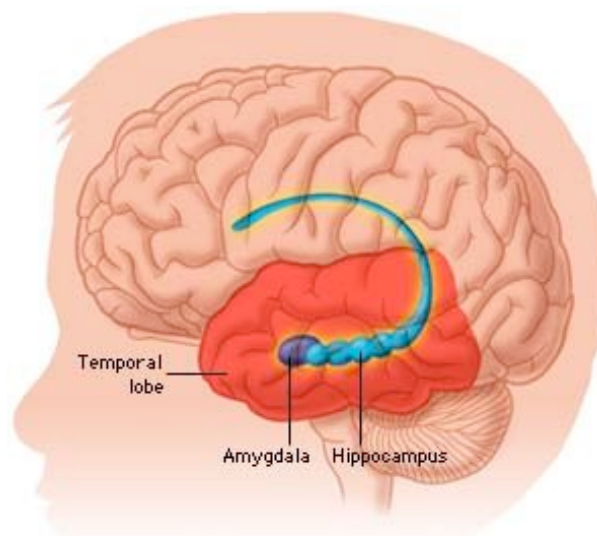
When twenty-seven year old Henry M. entered the hospital in 1953 for radical brain surgery that was supposed to cure his epilepsy, he was hopeful that the procedure would change his life for the better. Instead, it trapped him in a mental time warp where TV is always a new invention and Truman is forever president. The removal of large sections of his [temporal lobes](#) left Henry unable to form any new personal memories, but his tragic loss revolutionized the field of psychology and made "H.M." the most-studied individual in the history of brain research.

Henry grew up outside of Hartford, Connecticut, and was by all accounts an amiable young man with above average intelligence. He liked to go ice skating and to listen to mystery shows on the radio, which he enjoyed because he could often deduce the villain ahead of the program detective. Then on his sixteenth birthday, Henry had his first [grand mal seizure](#) during a celebratory trip to the city with his parents. After that point, the paralyzing seizures arrived with increasing frequency, until by the summer of 1953, he was experiencing as many as eleven episodes per week. He was unable to hold a steady job, and his prospects for independent living seemed dim. There were not many effective treatments available for epilepsy in 1953, so it was with a mixture of hope and trepidation that Henry's family turned to Dr. William Scoville and his experimental surgery.

The Fateful Surgery

The idea behind the surgery was simple. Seizures, as Scoville correctly reasoned, are caused by uncontrolled electrical impulses that start in a localized area and then spread throughout the rest of the brain. If one could remove the part of the brain where the seizures originated, it should be possible to cure the epilepsy. Henry had the most common form of the disease, called temporal lobe epilepsy, which meant that his seizures began in the tissue located on either side of his brain. Dr. Scoville removed a large chunk of Henry's right and left temporal lobes, which was a crucial decision because the brain is symmetrical and thus most important structures are duplicated. Altogether, Henry lost about a fist-sized portion of his brain, which encompassed (on both sides) the [hippocampus](#), the [amygdala](#), and the [entorhinal](#) and [perirhinal](#) cortices. As it turns out, the hippocampus is crucial for memory storage. When he lost his hippocampi, Henry became frozen in 1953, remembering very well the events before his operation but unable to create any new memories. He describes the experience like this:

"Right now, I'm wondering, have I done or said anything amiss? You see, at this moment everything looks clear to me, but what happened just before? That's what worries me. It's like waking from a dream. I just don't remember."



What Henry Can Remember, And What He Cannot

At the time of Henry's surgery, the study of memory was mostly limited to philosophical writings and introspective probing like the kind practiced by Sigmund Freud. In the 1930s, Karl Lashley began a

systematic quest to find the exact location of memory in the brain. He taught rats and monkeys a variety of tasks, then destroyed a part of their brain, reasoning that if the animals could not remember after the lesion, then he must have found the place where memories reside. After years of frustration, Lashley concluded that nothing short of near complete destruction of the brain caused the animals to forget their tasks, and it seemed that biological study of memory was not possible.

Then word began to spread of patient H.M., who had very localized brain damage but extreme memory deficits. Scientists were very interested in the precise nature of Henry's amnesia and began a careful study of which parts of his memory had been erased by the surgery and which parts remained intact. As noted before, he had good recall of facts learned before his operation, meaning that his long-term memory was unharmed. Also, Henry was able to hold information in storage for very short periods of time. Most people can retain about seven pieces of information (a telephone number, for example) in memory for about thirty seconds, and Henry scored normally on these kinds of tasks. Thus, his [working memory](#) (or scratch-pad memory) seemed unaffected by the loss of his hippocampus. The main problem for Henry was converting short-term memories into permanent storage, a process called consolidation.

Based on the patterns of Henry's memory loss, researchers formed the following hypotheses about memory formation:

- 1.) Short-term memories are biologically different from long-term memories because they do not require the hippocampus for formation.
- 2.) Long-term memories are stored throughout the brain, but the hippocampus is necessary for the information to reach long-term storage. Once the memory is permanently stored, however, the hippocampus is no longer required. Said another way: the hippocampus is important for long-term memory formation, but not for memory maintenance or retrieval.

This would explain why Henry can remember the events prior to his surgery but not store any new memories afterward. Even with thousands of repetitions, he is unable to learn new facts. His doctors must reintroduce themselves each morning, and Henry is never sure where he is for very long. Yet even as they marvel at the extent of his memory loss, researchers have found one other kind of memory task that Henry can perform normally: skill learning.

Often termed "[procedural memory](#)," skill learning is a kind of unconscious memory. You might recall your tennis lessons very well, but when you hit the ball over the net, there is no conscious awareness of each muscle group involved in the task. Your backhand is simply automatic. For Henry, these kinds of motor skills are also automatic. He does not remember learning them, but his performance improves over time. Learning to trace a star using a reflection in the mirror, for example, is a task that most people do not do well the first time they try it. But with practice, it becomes quite easy. Henry shows the same kind of improvement on the star-tracing task, even though each time he tries it, he claims to have never attempted it before. Thus, skill learning appears to be a special kind of long-memory that does not require the hippocampus.

Henry Right Now

Study of Henry's case has led to some very seminal findings about memory. Specifically, it seems that the hippocampus is required for the formation of conscious, long-term memories, but not for unconscious, long-term skill memories or short-term recall. Perhaps even more importantly, Henry has vividly illustrated that there is a biological basis for memory and that it is possible to use biological techniques to study a subject as elusive as memory.

As for Henry's current status, he lives in a nursing home in Hartford and still travels occasionally to MIT for memory testing. He enjoys doing crossword puzzles and watching detective shows on television. His life is peaceful, if not completely happy. He worries often that he has done something wrong, and it is not possible for him to make any real friends since he cannot remember a person from ten minutes to the next. At times, he seems to have a sense of humor about his condition, as in the following anecdote taken from his biography, *Memory's Ghost: The Strange Tale of Mr. M. and the Nature of Memory*, by Philip Hilts:

When walking down the corridor at M.I.T. with Henry, Dr. Suzanne Corkin made the usual kind of small talk. "Do you know where you are, Henry?"

Henry grinned. "Why, of course. I'm at M.I.T.!"

Dr. Corkin was a bit surprised. "How do you know that?"

Henry laughed. He pointed to a student nearby with a large M.I.T. emblazoned on his sweatshirt. "Got ya that time!" Henry said.

Mainly, though, he leads a life of quiet confusion, never knowing exactly how old he is (he guesses maybe thirty and is always surprised by his reflection in the mirror) and reliving his grief over the death of his mother every time he hears about it. Though he does not recall his operation, he knows that there is something wrong with his memory and has adopted a philosophical stance on his problems: "It does get me upset, but I always say to myself, what is to be is to be. That's the way I always figure it now."

Often, Henry will express the hope that others can learn from his unfortunate situation, as he told Philip Hilts in an interview several years ago:

"Well, what I keep thinking is that possibly I had an operation. And somehow the memory is gone...And I'm trying to figure it out...I think of it all the time. I don't remember this, and why I don't remember that."

"Is that worrisome?" Hilts wanted to know.

"Well, it isn't worrisome in a way, to me, because I know that if they ever performed an operation on me, they'd learn from it. It would help others."

Sadly, the very nature of his memory loss prevents Henry from ever knowing the incredible contribution he has made to the field of psychology, but his tale stands as an important prologue to the ongoing story of memory research. Long after Henry passes on, "H.M." will be studied as the man whose unwitting sacrifice first vividly illustrated the important link between memory and brain.

Source: <http://web.archive.org/web/20071005050947/www.brainconnection.com/topics/?main=fa/hm-memory>

He knew his name. That much he could remember.

He knew that his father's family came from Thibodaux, La., and his mother was from Ireland, and he knew about the 1929 stock market crash and World War II and life in the 1940s.

But he could remember almost nothing after that.

In 1953, he underwent an experimental brain operation in Hartford to correct a seizure disorder, only to emerge from it fundamentally and irreparably changed. He developed a syndrome neurologists call profound amnesia. He had lost the ability to form new memories.

For the next 55 years, each time he met a friend, each time he ate a meal, each time he walked in the woods, it was as if for the first time.

And for those five decades, he was recognized as the most important patient in the history of brain science. As a participant in hundreds of studies, he helped scientists understand the biology of learning, memory and physical dexterity, as well as the fragile nature of human identity.

On Tuesday evening at 5:05, Henry Gustav Molaison — known worldwide only as H. M., to protect his privacy — died of respiratory failure at a nursing home in Windsor Locks, Conn. His death was confirmed by Suzanne Corkin, a neuroscientist at the Massachusetts Institute of Technology, who had worked closely with him for decades. Henry Molaison was 82.

From the age of 27, when he embarked on a life as an object of intensive study, he lived with his parents, then with a relative and finally in an institution. His amnesia did not damage his intellect or radically change his personality. But he could not hold a job and lived, more so than any mystic, in the moment.

“Say it however you want,” said Dr. Thomas Carew, a neuroscientist at the University of California, Irvine, and president of the Society for Neuroscience. “What H. M. lost, we now know, was a critical part of his identity.”

At a time when neuroscience is growing exponentially, when students and money are pouring into laboratories around the world and researchers are mounting large-scale studies with powerful brain-imaging technology, it is easy to forget how rudimentary neuroscience was in the middle of the 20th century.

When Mr. Molaison, at 9 years old, banged his head hard after being hit by a bicycle rider in his neighborhood near Hartford, scientists had no way to see inside his brain. They had no rigorous understanding of how complex functions like memory or learning functioned biologically. They could not explain why the boy had developed severe

seizures after the accident, or even whether the blow to the head had anything do to with it.

Eighteen years after that bicycle accident, Mr. Molaison arrived at the office of Dr. William Beecher Scoville, a neurosurgeon at Hartford Hospital. Mr. Molaison was blacking out frequently, had devastating convulsions and could no longer repair motors to earn a living.

After exhausting other treatments, Dr. Scoville decided to surgically remove two finger-shaped slivers of tissue from Mr. Molaison's brain. The seizures abated, but the procedure — especially cutting into the hippocampus, an area deep in the brain, about level with the ears — left the patient radically changed.

Alarmed, Dr. Scoville consulted with a leading surgeon in Montreal, Dr. Wilder Penfield of McGill University, who with Dr. Brenda Milner, a psychologist, had reported on two other patients' memory deficits.

Soon Dr. Milner began taking the night train down from Canada to visit Mr. Molaison in Hartford, giving him a variety of memory tests. It was a collaboration that would forever alter scientists' understanding of learning and memory.

“He was a very gracious man, very patient, always willing to try these tasks I would give him,” Dr. Milner, a professor of cognitive neuroscience at the Montreal Neurological Institute and McGill University, said in a recent interview. “And yet every time I walked in the room, it was like we'd never met.”

At the time, many scientists believed that memory was widely distributed throughout the brain and not dependent on any one neural organ or region. Brain lesions, either from surgery or accidents, altered people's memory in ways that were not easily predictable. Even as Dr. Milner published her results, many researchers attributed H. M.'s deficits to other factors, like general trauma from his seizures or some unrecognized damage.

“It was hard for people to believe that it was all due” to the excisions from the surgery, Dr. Milner said.

That began to change in 1962, when Dr. Milner presented a landmark study in which she and H. M. demonstrated that a part of his memory was fully intact. In a series of trials, she had Mr. Molaison try to trace a line between two outlines of a five-point star, one inside the other, while watching his hand and the star in a mirror. The task is difficult for anyone to master at first.

Every time H. M. performed the task, it struck him as an entirely new experience. He had no memory of doing it before. Yet with practice he became proficient. “At one point he said to me, after many of these trials, ‘Huh, this was easier than I thought it would be,’ ” Dr. Milner said.

The implications were enormous. Scientists saw that there were at least two systems in the brain for creating new memories. One, known as declarative memory, records names, faces and new experiences and stores them until they are consciously retrieved. This system depends on the function of medial temporal areas, particularly an organ called the hippocampus, now the object of intense study.

Another system, commonly known as motor learning, is subconscious and depends on other brain systems. This explains why people can jump on a bike after years away from one and take the thing for a ride, or why they can pick up a guitar that they have not played in years and still remember how to strum it.

Soon “everyone wanted an amnesic to study,” Dr. Milner said, and researchers began to map out still other dimensions of memory. They saw that H. M.’s short-term memory was fine; he could hold thoughts in his head for about 20 seconds. It was holding onto them without the hippocampus that was impossible.

“The study of H. M. by Brenda Milner stands as one of the great milestones in the history of modern neuroscience,” said Dr. Eric Kandel, a neuroscientist at Columbia University. “It opened the way for the study of the two memory systems in the brain, explicit and implicit, and provided the basis for everything that came later — the study of human memory and its disorders.”

Living at his parents’ house, and later with a relative through the 1970s, Mr. Molaison helped with the shopping, mowed the lawn, raked leaves and relaxed in front of the television. He could navigate through a day attending to mundane details — fixing a lunch, making his bed — by drawing on what he could remember from his first 27 years.

He also somehow sensed from all the scientists, students and researchers parading through his life that he was contributing to a larger endeavor, though he was uncertain about the details, said Dr. Corkin, who met Mr. Molaison while studying in Dr. Milner’s laboratory and who continued to work with him until his death.

By the time he moved into a nursing home in 1980, at age 54, he had become known to Dr. Corkin’s M.I.T. team in the way that Polaroid snapshots in a photo album might sketch out a life but not reveal it whole.

H. M. could recount childhood scenes: Hiking the Mohawk Trail. A road trip with his parents. Target shooting in the woods near his house.

“Gist memories, we call them,” Dr. Corkin said. “He had the memories, but he couldn’t place them in time exactly; he couldn’t give you a narrative.”

He was nonetheless a self-conscious presence, as open to a good joke and as sensitive as anyone in the room. Once, a researcher visiting with Dr. Milner and H. M. turned to her and remarked how interesting a case this patient was.

“H. M. was standing right there,” Dr. Milner said, “and he kind of colored — blushed, you know — and mumbled how he didn’t think he was that interesting, and moved away.”

In the last years of his life, Mr. Molaison was, as always, open to visits from researchers, and Dr. Corkin said she checked on his health weekly. She also arranged for one last research program. On Tuesday, hours after Mr. Molaison’s death, scientists worked through the night taking exhaustive M.R.I. scans of his brain, data that will help tease apart precisely which areas of his temporal lobes were still intact and which were damaged, and how this pattern related to his memory.

Dr. Corkin arranged, too, to have his brain preserved for future study, in the same spirit that Einstein’s was, as an irreplaceable artifact of scientific history.

“He was like a family member,” said Dr. Corkin, who is at work on a book on H. M., titled “A Lifetime Without Memory.” “You’d think it would be impossible to have a relationship with someone who didn’t recognize you, but I did.”

In his way, Mr. Molaison did know his frequent visitor, she added: “He thought he knew me from high school.”

Henry Gustav Molaison, born on Feb. 26, 1926, left no survivors. He left a legacy in science that cannot be erased.